

THE UNIVERSITY OF OKLAHOMA
GRADUATE COLLEGE

IRRIGATION EFFICIENCY AND PRODUCTION ENERGY EFFICIENCY
OF TRADITIONAL AND MODERN FARMS
IN THE AL-HASSA OASIS,
SAUDI ARABIA

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ABSTRACT

The Al-Hassa Oasis with a total population of 234,703 (1974) is located in the eastern province of Saudi Arabia. The average rainfall is about 72mm per year. Farming is the main occupation in the Oasis. The dry tropical climate requires irrigation throughout the year for agricultural crop production.

Agricultural crop production in the Oasis currently faces the following problems: declining groundwater tables, scarcity of surface water, high soil salinity in substantial parts of the districts serviced by the irrigation authority, low efficiency of irrigation water use in fields, rising costs for production inputs, and declining crop yields.

Due to limited availability of irrigation water, increasing irrigation efficiency is essential to reduce the agricultural water demand and to mitigate groundwater depletion. Knowledge of production energy input/food energy output relationships is essential to select the most energy efficient crops when cultural energy savings per food energy unit are the prime planning objective.

The objectives of this research are to assess field irrigation efficiency under traditional, intermediate, and modern irrigation methods, to calculate energy efficiency under traditional, intermediate, and modern soil management practices, and to determine the relationship between irrigation efficiency and production energy efficiency within the current agricultural scenario of the Oasis.

The data have been raised by surveying 144 fields on 42 farms. An integrative program for personal computers calculates fields energy budgets. The results indicate that modern irrigation methods reach highest levels of average field irrigation efficiency and traditional irrigation methods achieve the lowest levels. Also modern agricultural practices show the highest average levels of energetic performance. The results of the analysis of variance (two-way) indicate that there are large differences between the means of field irrigation efficiency and the means of production energy efficiency with respect to irrigation methods and types of crops.

Regression analyses regarding the relationship between (1) food energy output and irrigation energy input, non-irrigation energy input and irrigation efficiency, (2) irrigation efficiency and total cultural energy input, (3) irrigation efficiency and irrigation energy input, (4) food energy output and cultural energy input, (5) production energy efficiency and irrigation efficiency under tomatoes, cucumber, potatoes, other vegetables, alfalfa, wheat, dates, and rice indicate that the effect of the independent variable(s) on the dependent variable varies from one crop to another.

Based on irrigation and energy budget analyses the following recommendations are suggested to the Ministry of Agricultural and Water and to the farmers in the Oasis: (1) Modernize traditional and intermediate irrigation methods on as many acres as feasible. (2) Rice should be widely replaced by other crops. (3) Introduce small greenhouses on as many private farms as possible. (4) Develop agricultural extension service programs and training programs that

